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Raining onto black holes: chaotic cold accretion driving AGN feedback

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It is commonly thought that supermassive black holes mainly accrete the hot gas from the surrounding intracluster medium, following the classic Bondi theory. However, in the presence of heating and turbulence due to the AGN feedback, cold clouds and filaments condense out of the hot phase via nonlinear thermal instability, up to 10s kpc radii. Through unprecedented 3D hydrodynamic simulations reaching a dynamical range up to 10 million, we show that the chaotic inelastic collisions between the cold clouds, filaments, and central torus, promote angular momentum cancellation down to the inner sub-pc region, thus boosting the accretion rate up to 100 times the hot Bondi rate, or comparable to the gas cooling rate. We also present new AMR simulations studying the impact of rotation on the accretion flow with different ICM physics. Chaotic cold accretion is crucial to trigger powerful AGN outflows, which can quench the cooling flow and star formation. We discuss how cold accretion creates a symbiotic link between the black hole and the host galaxy, leading to a tight self-regulated feedback loop, which preserves the cores of groups and clusters in quasi thermal equilibrium throughout cosmic history.

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